



Light Emitting Diodes (LEDs) for Airport Lighting

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LEDs for Airport Lighting Agenda

- *“The Challenges”*
- *Technology Development: Accomplishments and Future Plans*
- Airport Lighting Power Infrastructure Feasibility Study
- LED Runway Guard Light (RGL) Evaluation
- Prototype LED Airport Lighting System
- Life Cycle Cost Comparison (LCCC) Web Tool

- *Lagniappe (LAN yap) – A little something extra*
 - FAA LED Development for *Approach Lighting Systems*
 - Runway Safety Systems Research Projects
 - RGL effectiveness as a runway incursion prevention tool
 - Runway Status Lights (RWSL)

LEDs for Airport Lighting

"The Challenges"

- Developing FAA Specifications, Standards and Design Guidance for LEDs to be used as a light source in traditional airport lighting systems.
 - Photometric Standards
 - Qualification and Production Testing
 - Human Factors and Configuration Management
 - *(Do LED light units appear different from incandescent light units to a pilot?)*
- Designing a Power Infrastructure to maximize the benefits of LED technology.
 - Transitional Infrastructure *(replace traditional light fixture with a LED fixture, along with modified CCR and Transformer using existing cable.)*
 - New Infrastructure *(replace traditional light fixture with LED fixture, along with modified components and smaller cable.)*

LEDs for Airport Lighting Accomplishments and Future Work Plan

- Fiscal Year '04
 - Published a Feasibility Study “*Affordable Alternative Airport Electrical Power Distribution Infrastructure*”.
 - Conducted Operational Readiness assessment of Prototype LED Runway Guard Lights (RGLs).
- Fiscal Year '05
 - Prototype LED Airport Lighting System Design for Installation and Evaluation at Prescott Municipal Airport (PRC).
- Why?
 - Safety enhancement research to address FAA runway incursion reduction goals
 - Manufacture development of LED Airfield Lights. (First generation was a retrofit...Additional benefits could be accomplished with a redesigned power infrastructure.)

LEDs for Airport Lighting Feasibility Study

- Published a Feasibility Study “*Affordable Alternative Airport Electrical Power Distribution Infrastructure*”.
- Feasibility Study Summary
 - *Reduced Energy Cost*
 - *Longer Fixture Lamp Life*
 - *Reduced Airport Operational and Maintenance Costs*
 - *Lower Life-Cycle Costs*
 - Smaller circuit components
 - Reduced number of components
 - Increased Visual Aids at Smaller Airports... *Ultimately Increased Aviation Safety.*
 - Today’s airport lighting system power infrastructure is not designed to maximize the potential benefits LED lighting fixtures.

LEDs for Airport Lighting

LED Elevated Runway Guard Light (ERGL) Evaluation

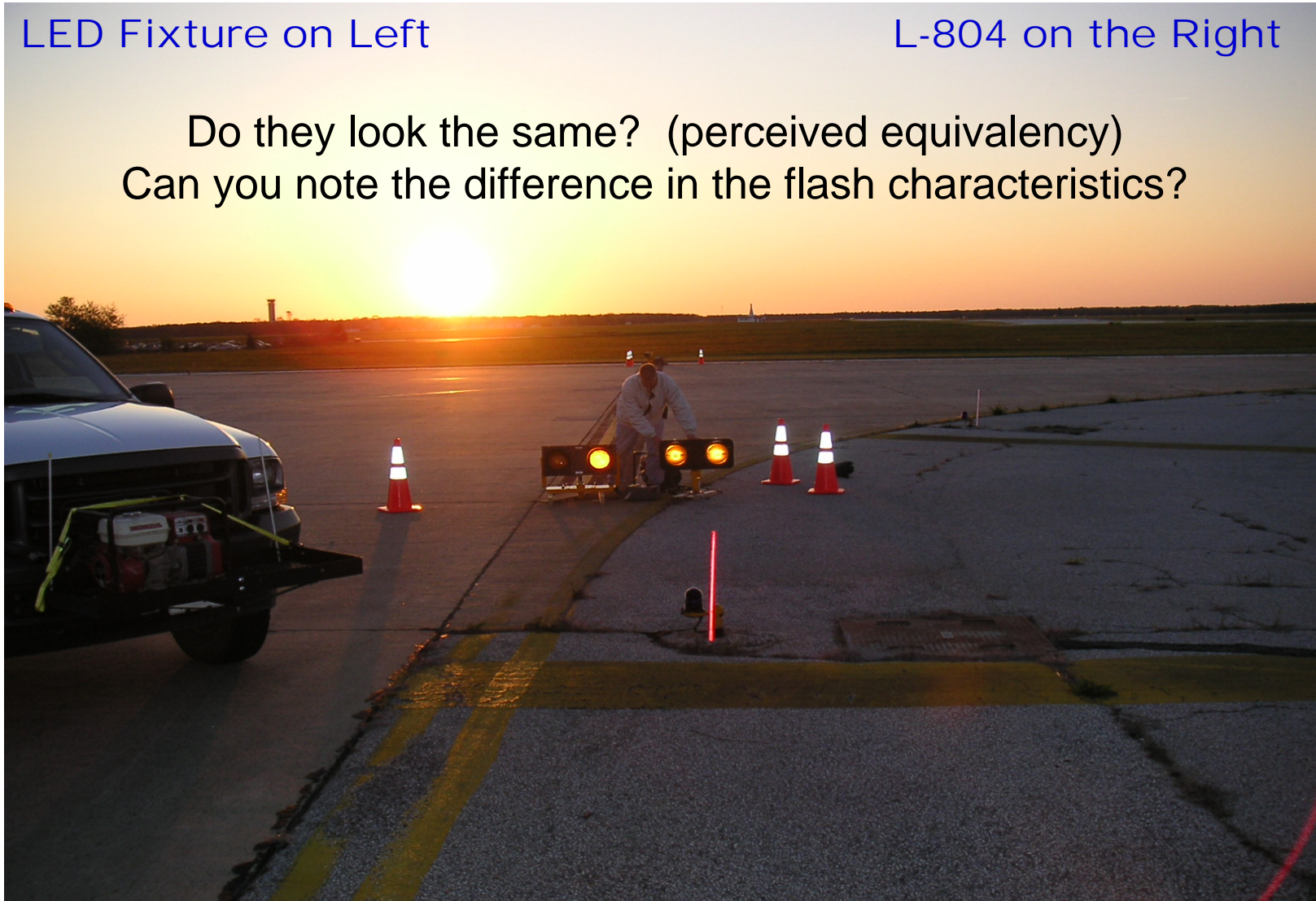
- Conspicuity Evaluation: *LED ERGLs vs. certified ERGLs*
- Laboratory testing
- LED ERGL Operational Evaluation at Phoenix Sky Harbor International Airport (PHX)
- Operational Readiness Report (July '05)
- Field Evaluation of LED ERGLs: Install and Evaluation system performance and benefits of ERGL at Prescott Municipal Airport (PRC) (*Fall '05 – Spring '06*)

LEDs for Airport Lighting LED ERGL Conspicuity Evaluation

LED Fixture on Left

L-804 on the Right

Do they look the same? (perceived equivalency)
Can you note the difference in the flash characteristics?



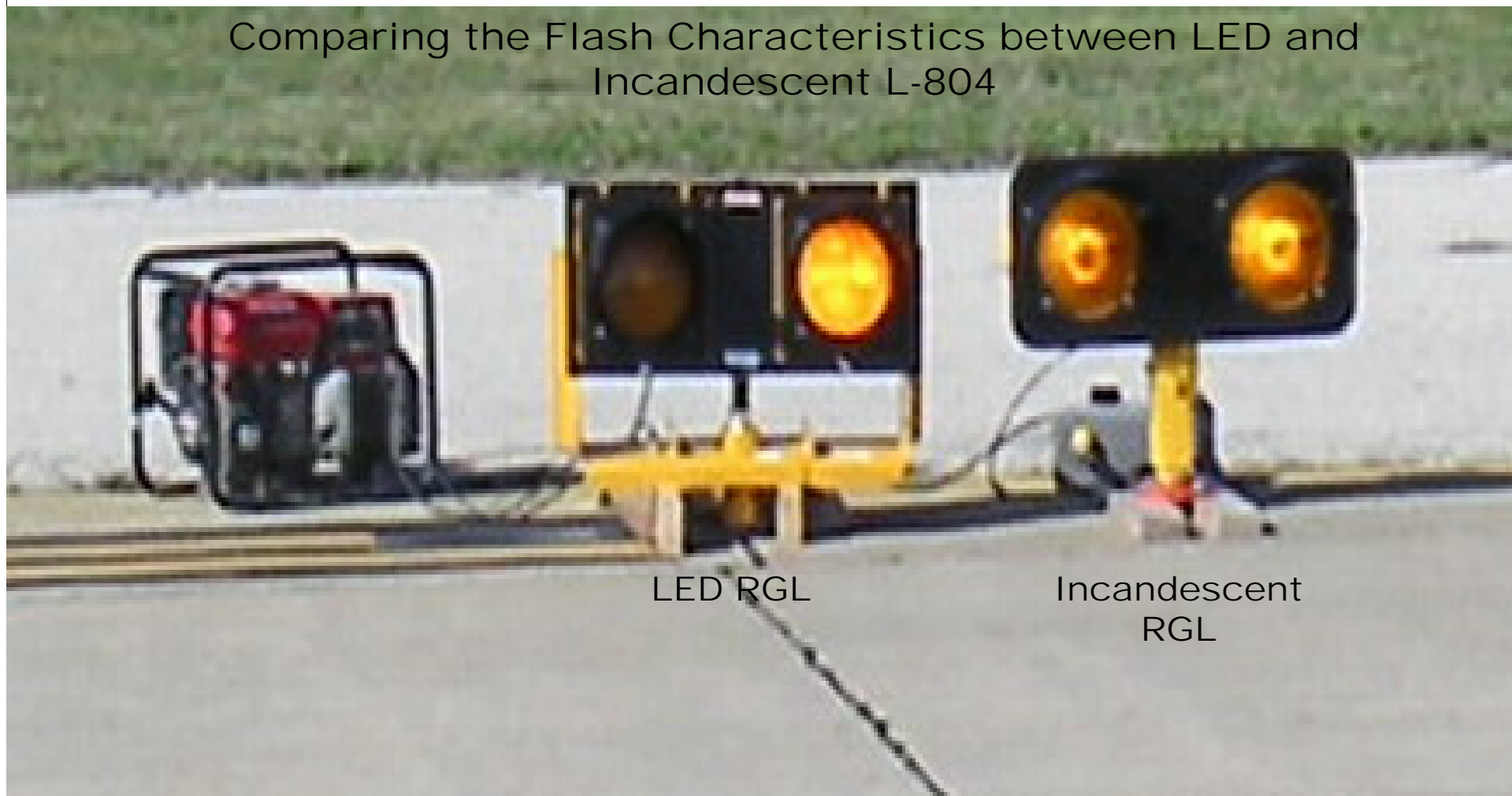
LEDs for Airport Lighting Runway Guard Lights



LEDs Airport Lighting

LED RGL Conspicuity Evaluation

Comparing the Flash Characteristics between LED and Incandescent L-804



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LED ERGL - Operational Evaluation



LEDs for Airport Lighting LED Prototype System



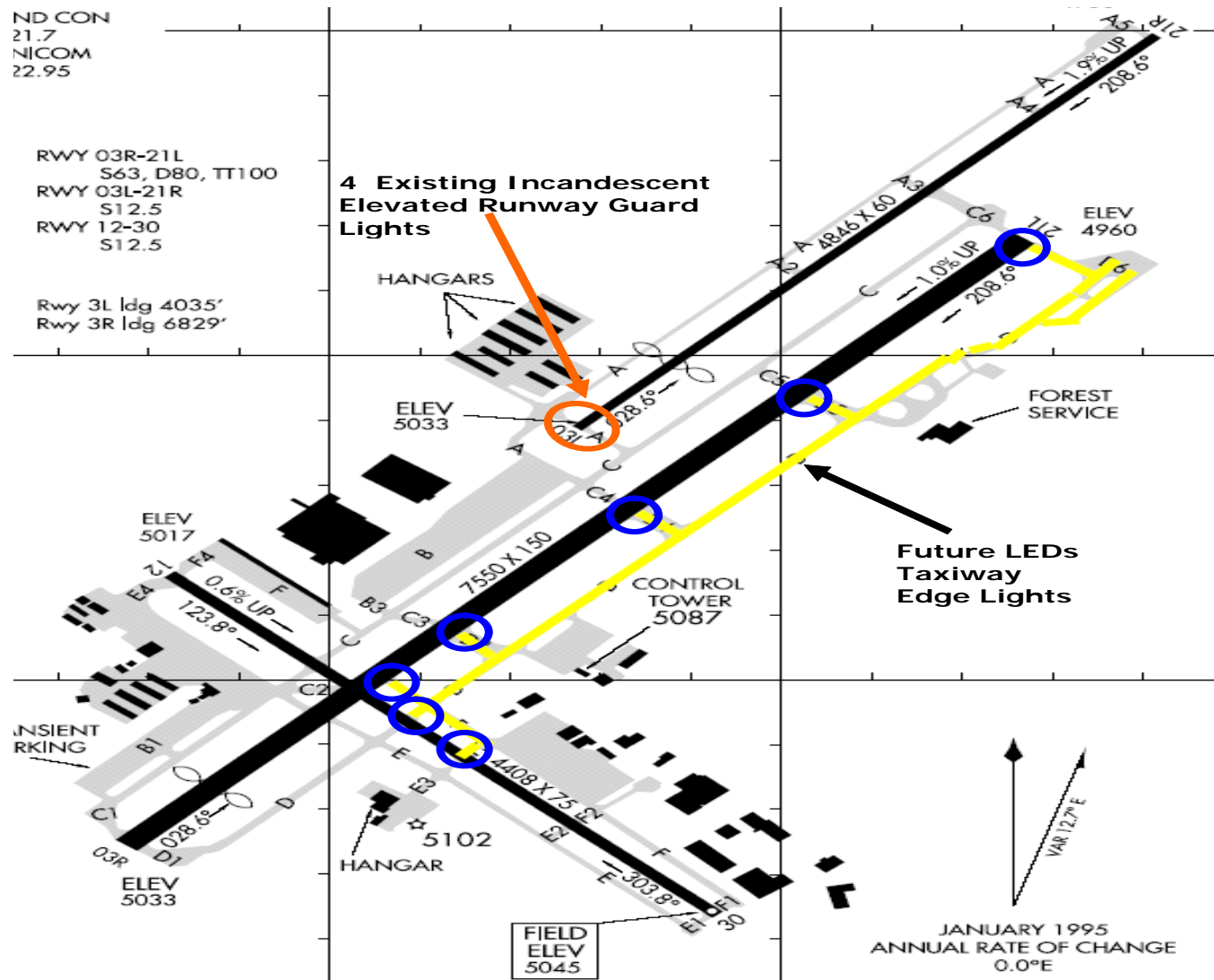
Prescott Municipal Airport (PRC) Prototype LED Lighting System Overview

Life Cycle Cost Comparison (LCCC) Web Tool Demonstration

Seward Ford

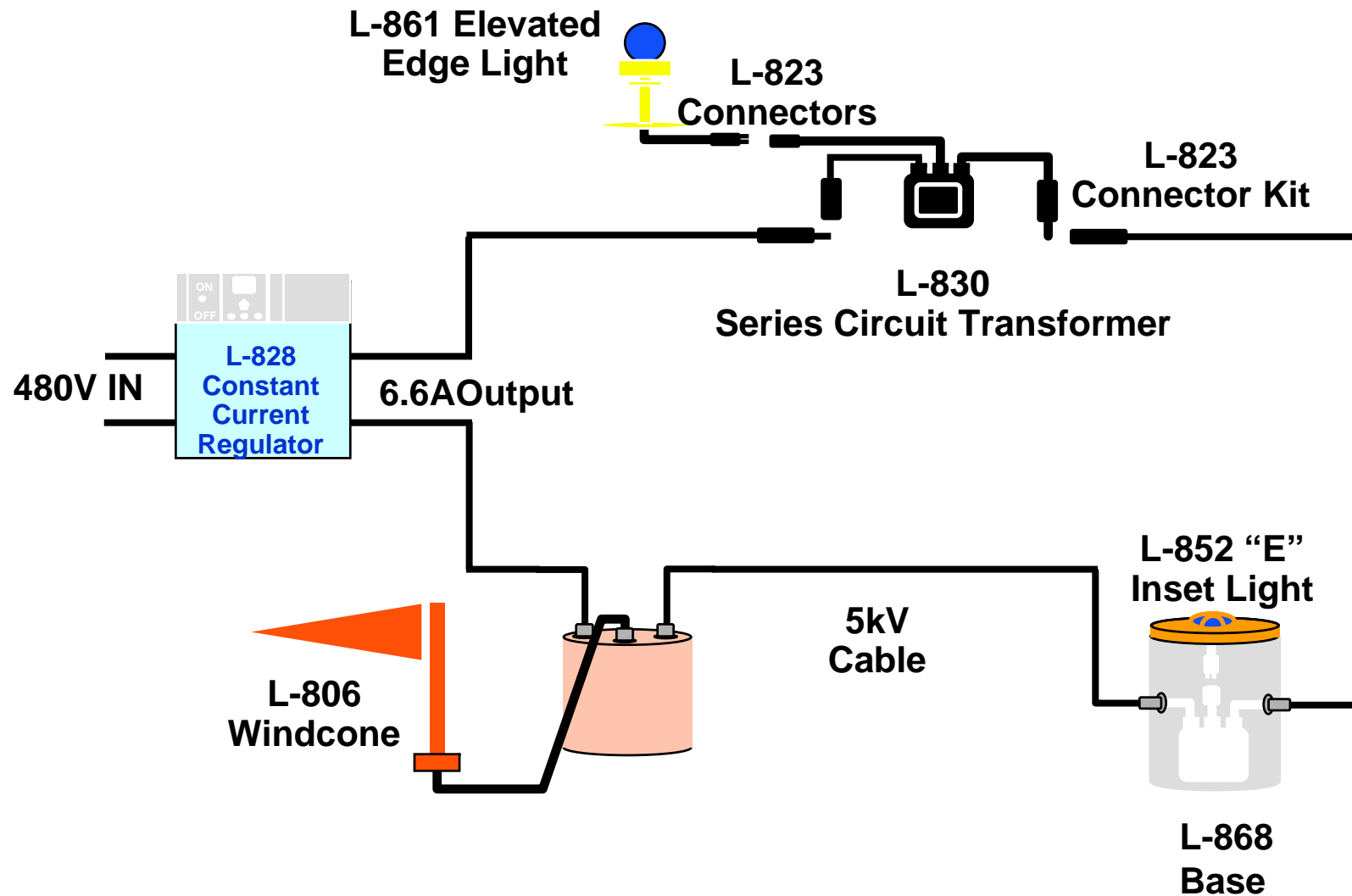


LEDs for Airport Lighting Prototype System Airport Layout (PRC)



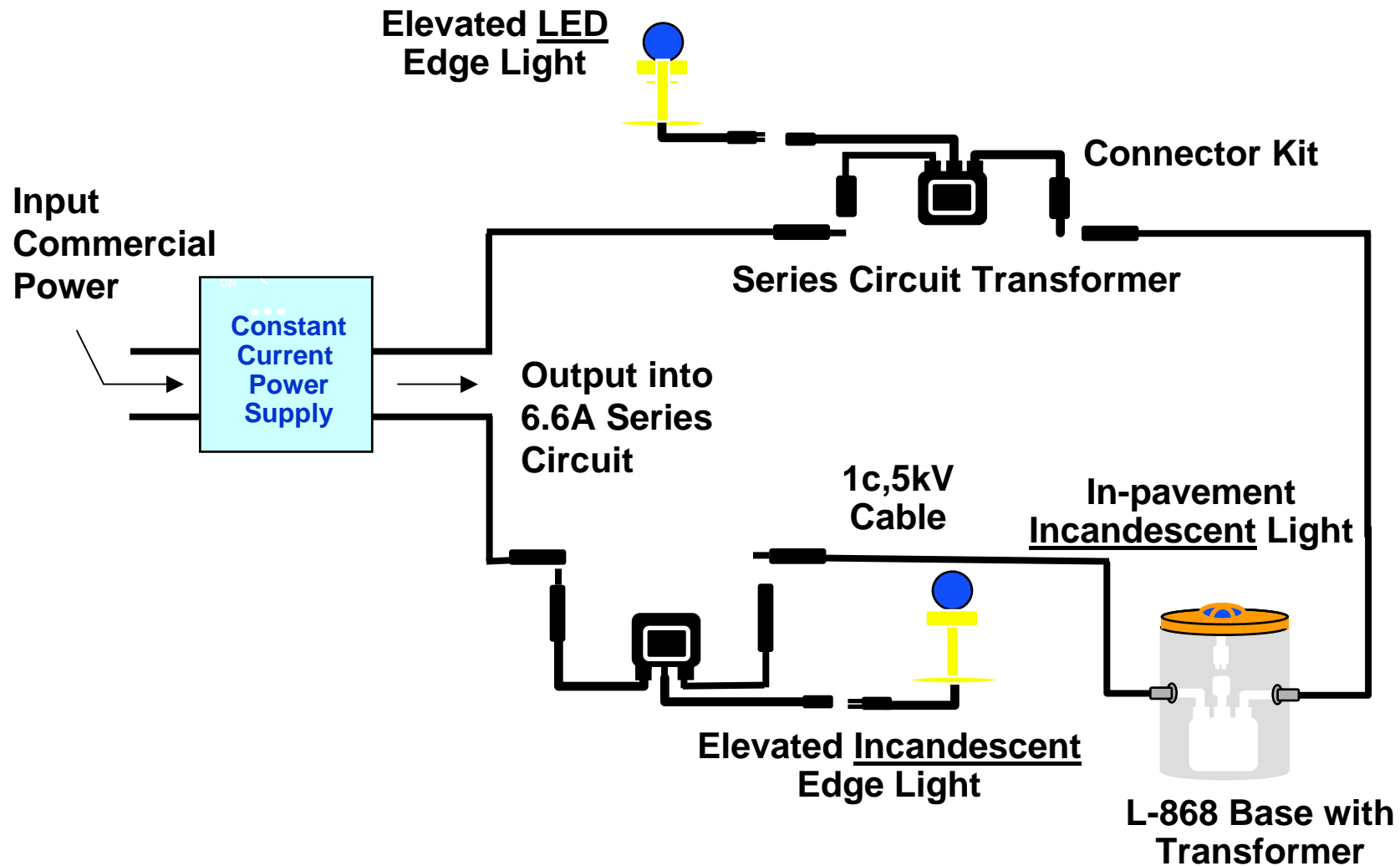
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Today's Airport Lighting Infrastructure



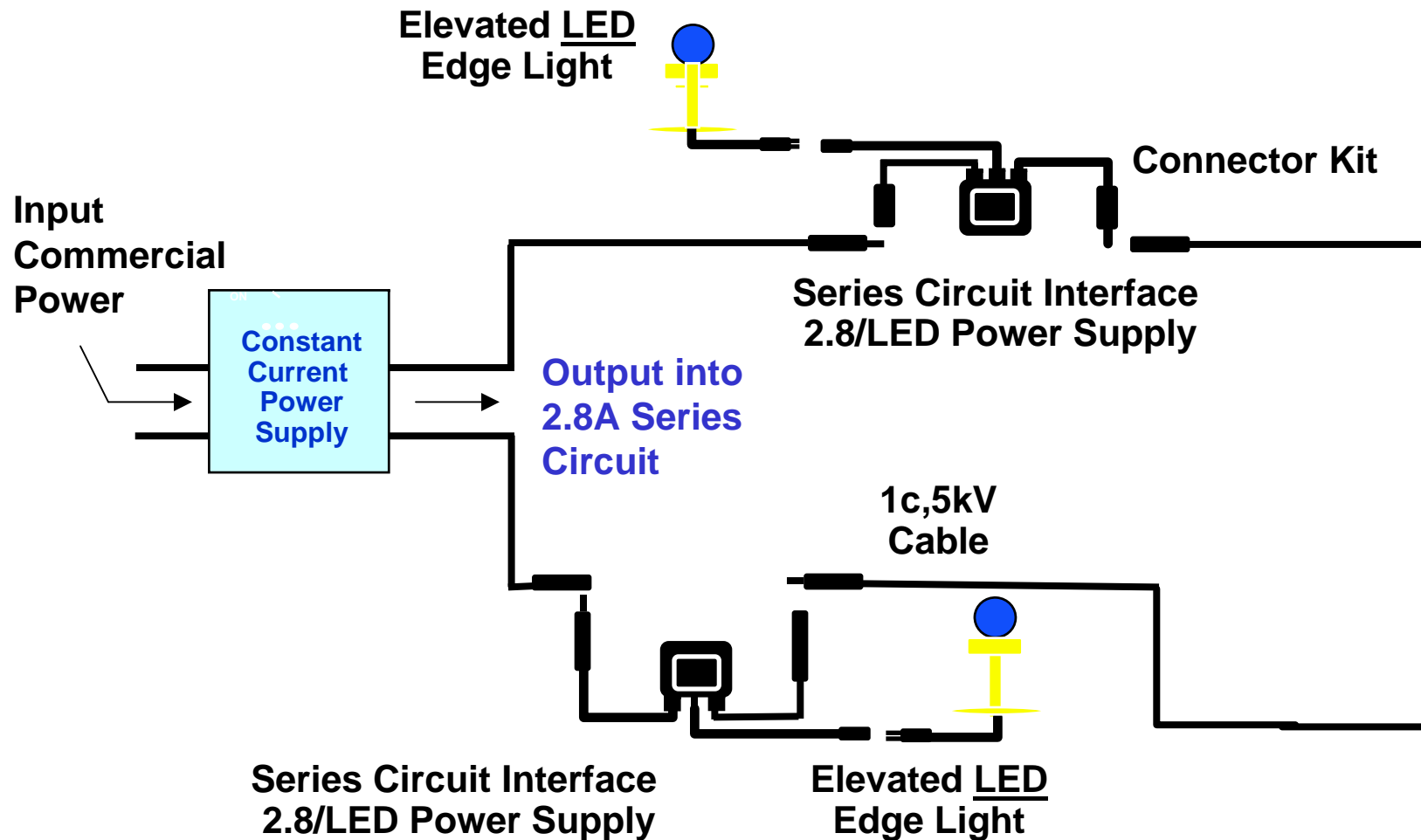
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Typical Taxiway Circuit with LED retrofit (*First Generation*)



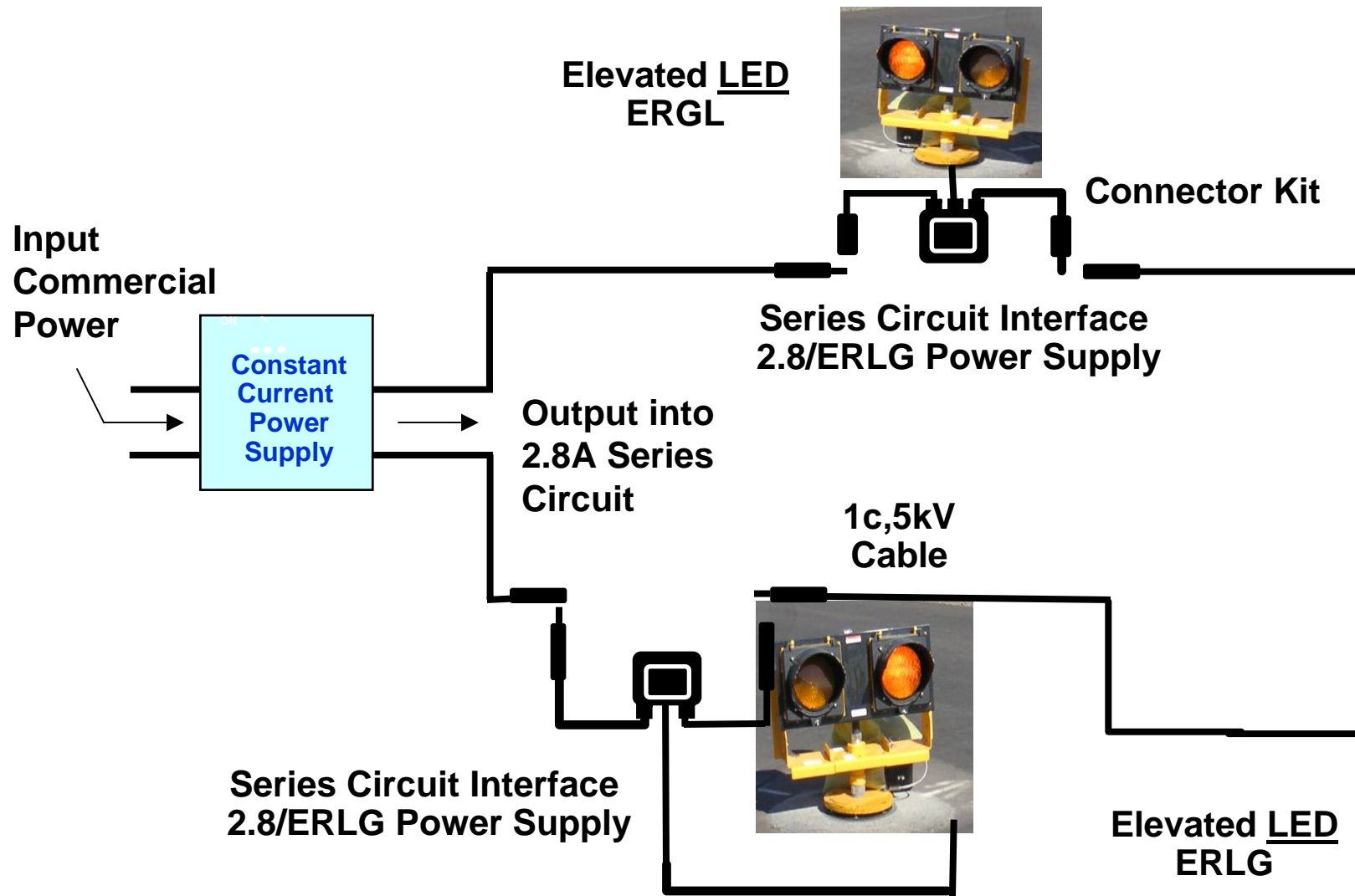
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LED Taxiway Circuit w/alternative power infrastructure



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LED ERGL Lighting Circuit w/alternative power infrastructure



LEDs for Airport Lighting Standard vs. Prototype LED Equipment List

Incandescent Lighting System (Current FAA Standard)	LED Lighting System (Prototype)
Incandescent Elevated Taxiway Edge Light	LED Elevated Taxiway Edge Light
6.6 Amp Constant Current Regulator	2.8A Amp Constant Current Regulator
30/45 Watt Series Circuit Transformer	7.5 Watt Series Circuit Interface
Cable Conductor Size #8	Cable Conductor Size #12 or #14
2-Inch Cable Conduit	1-Inch Cable Conduit
The following is a comparison of the estimated size of the primary power distribution gear used between an Incandescent (142 kW) airfield lighting design and a comparable LED (26 kW) airfield lighting design	
300kW Generator	60kW Generator
400 Amp Transfer Switch	125 Amp Transfer Switch
400 Amp MCB Main Panel	100 Amp MCB Main Panel
400 Amp MCB Emergency Panel	100 Amp MCB Emergency Panel

LEDs for Airport Lighting Prototype System (Current Status)

- *Crouse Hinds Airfield Lighting* was selected to build prototype LED lighting system, including both a taxiway edge lighting system and a LED ERGL system.
- Component Level Design and Testing (Summer '05)
- System Level Testing (Summer '05)
- LED Prototype Airfield Lighting System Installation at Prescott Municipal Airport (PRC) (Fall '05)
- Life Cycle Cost Analysis Web Tool (Fall '05)
- Evaluation of Prototype system (Verify System Performance and benefits predictions documented in Feasibility Study) (Spring '06)

LEDs for Airport Lighting Life Cycle Cost Comparison (LCCC) Web Tool

- What?
 - The Lifecycle Cost Comparison Calculator is an online web application currently under development to provide a life cycle cost comparison of incandescent taxiway lighting systems vs. LED taxiway lighting systems.
- Key Features
 - Ability to compare a life cycle (installation and O&M) cost of LED circuit vs. the standard incandescent circuit.
- Potential Users
 - Designers, Airport Engineers, etc.
- LCCC Demonstration to follow

LEDs for Airport Lighting

Thank You
Questions and Discussion



"Lagniappe"

A little something extra

FAA LED Development for *Approach Lighting Systems* Runway Safety Systems Research Projects

RGL effectiveness as a runway incursion prevention tool

Runway Status Lights (RWSL)



FAA Approach Lighting Systems LED Research and Development

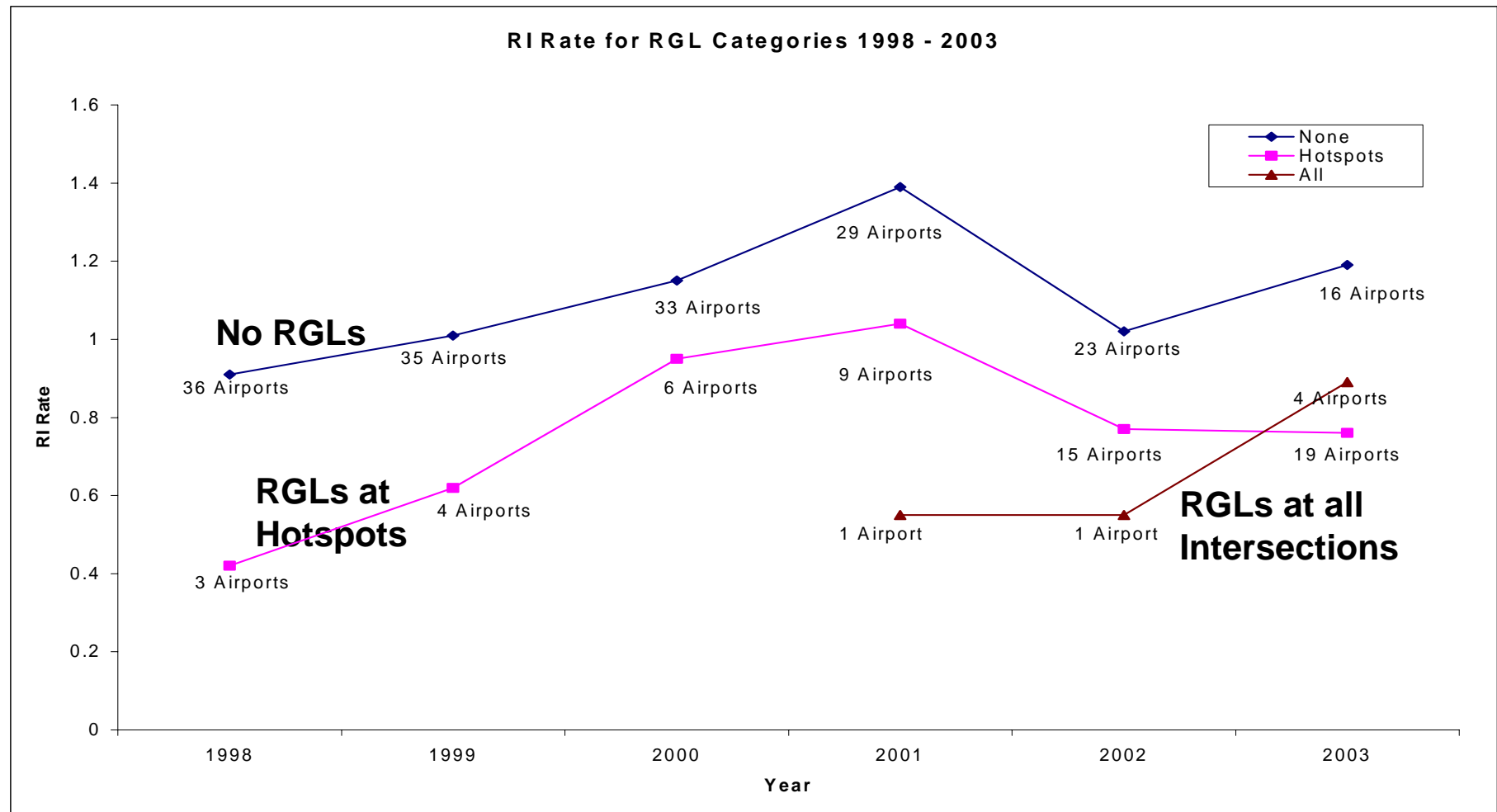
- Medium Intensity Approach Lighting System (MALSR)
 - Threshold hold lighting lamps (green)
 - Conducted environmental testing
 - Field evaluation currently being conducted at Grand Folks ND and Phoenix, AZ
 - Completed initial Cost Benefit Analysis
 - Future work – Develop procurement specification
 - Steady Burning White Lamps
 - Prototype lamps developed
 - Environmental testing on lamps (Coming Soon!)
 - Preliminary flight evaluation (Coming Soon!).

FAA Approach Lighting Systems LED Research and Development

- White Lamp for Approach Lighting System Flashers
 - Feasibility study conducted for using LED for MALSR flashers.
 - Develop prototype MALSR LED flasher system to replicate the “rolling ball of light” effect. (Coming Soon!)
- Develop prototype ALSF-2 white lamps. (Coming Soon!)
- Conduct Testing of IR Signature for White LEDs in May 2005 at 3rd Party Test Lab.

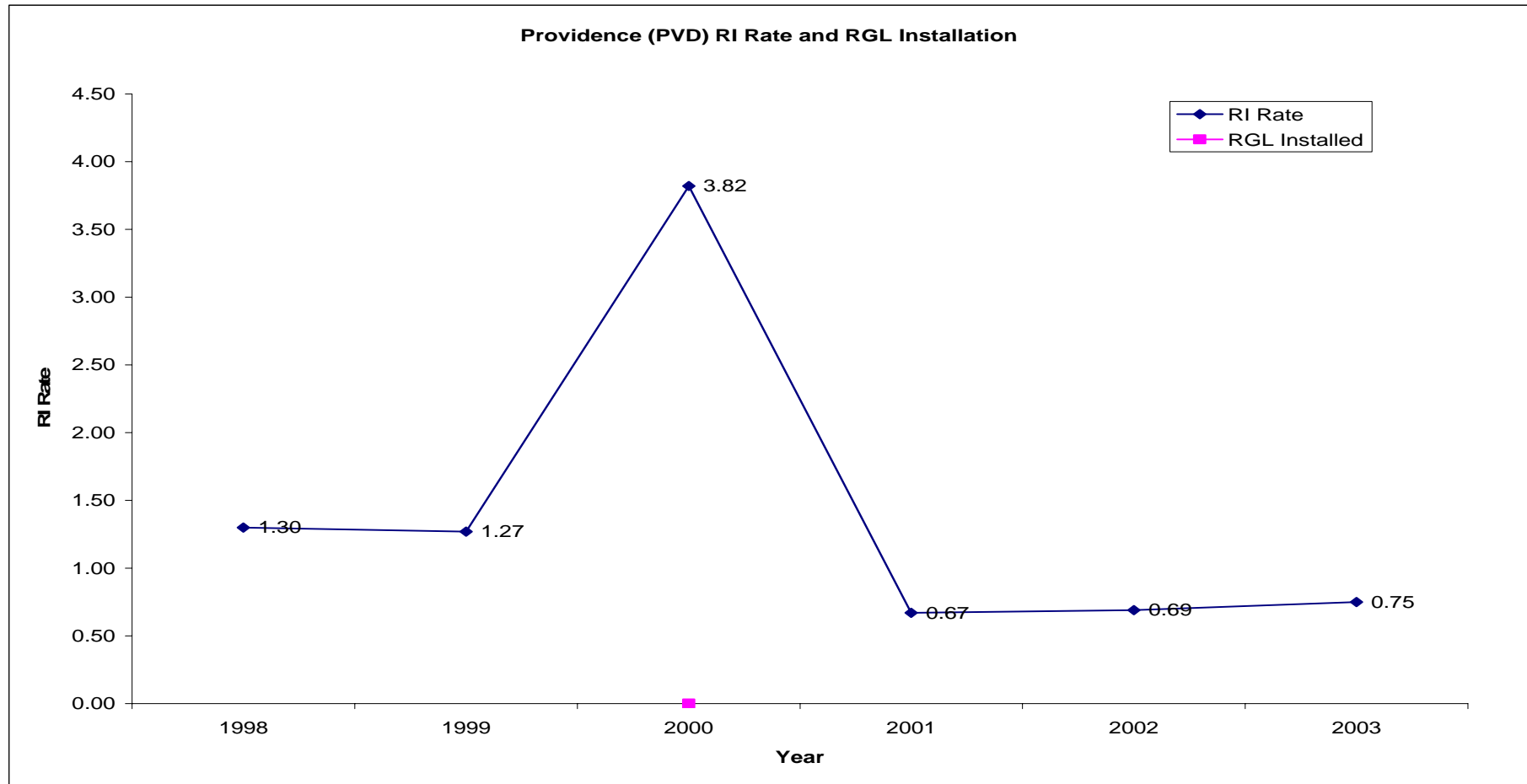
RGL Effectiveness Assessment

RI Data for Top 39 RI Airports



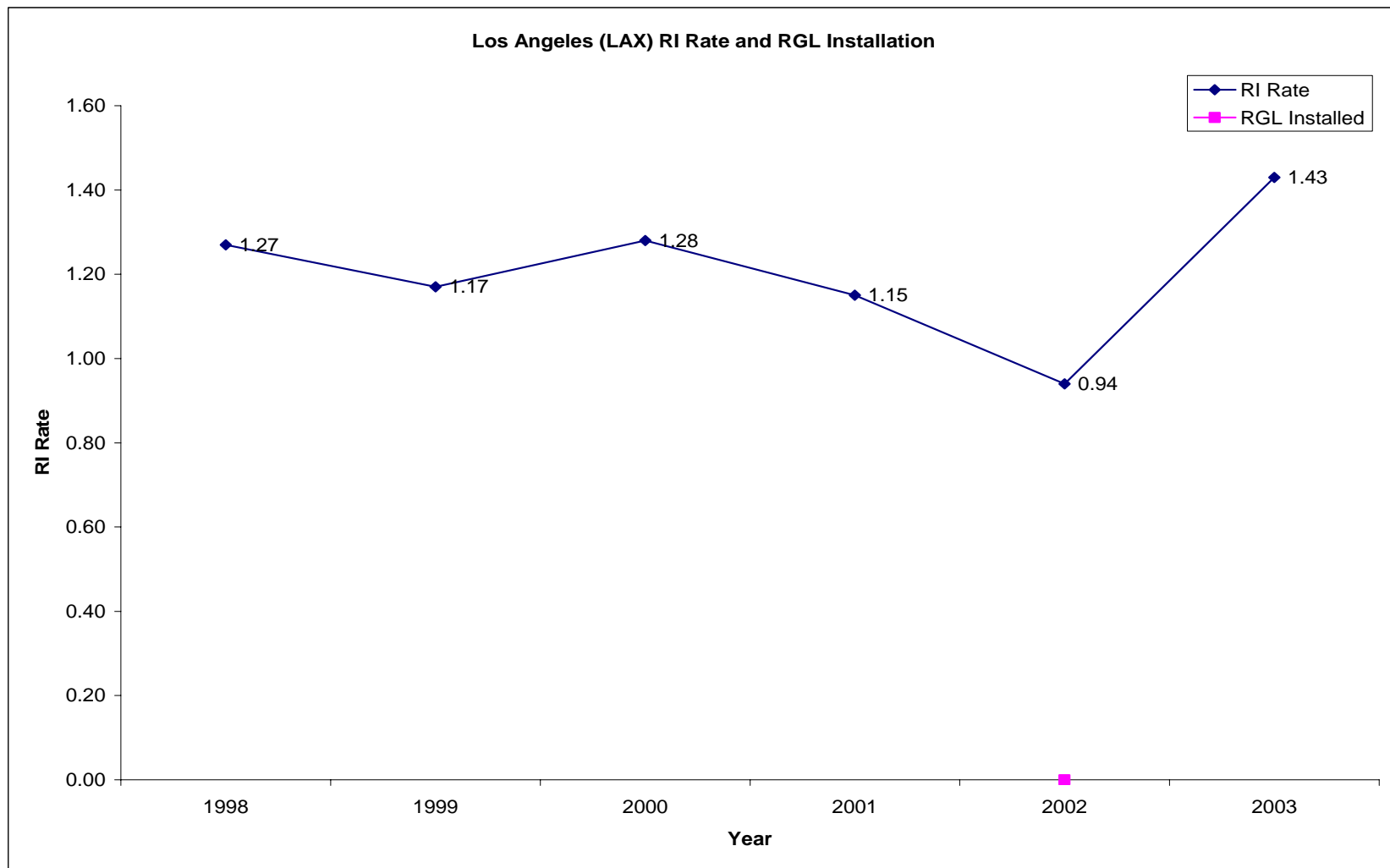
- 23 (58%) of the top 39 runway incursion airports have RGLs installed

RGL Effectiveness Assessment Providence (PVD) Data



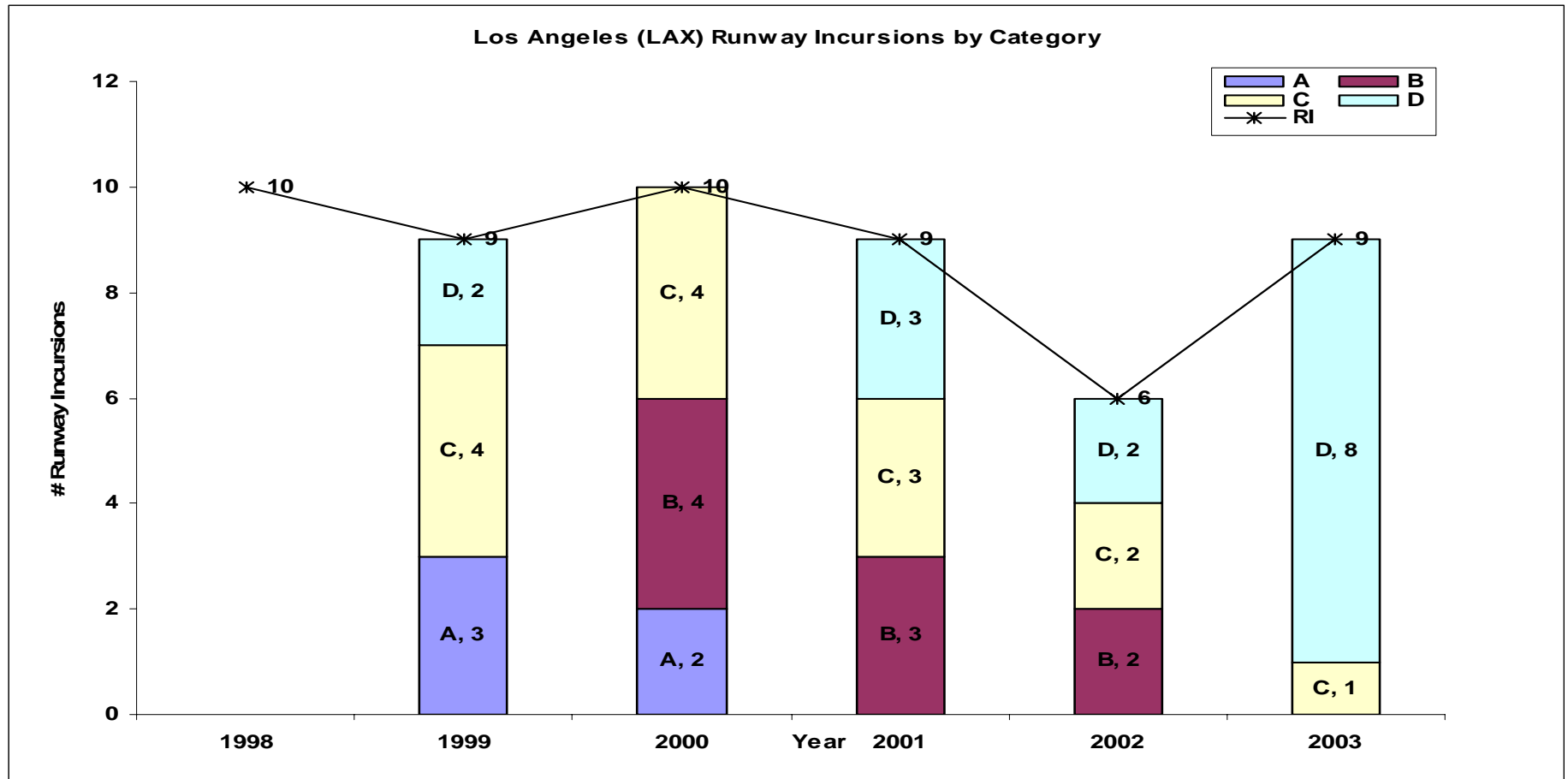
- PVD is an example of showing a *decreased RI rate following RGL activation*
- 63% of Airports with RGLs have experienced a decrease in the RI rate following the RGL activation

RGL Effectiveness Assessment Los Angeles (LAX) Data



- LAX is an example of showing a slightly increased runway incursion rate following RGL activation ...

RGL Effectiveness Assessment Los Angeles (LAX) Data



- LAX is an example of an airport showing a *decrease in severity of runway incursions* following RGL activation
- 88% of Airports with RGLs have experienced a decrease in runway incursion severity

RGL Effectiveness Assessment Conclusions

Based on Controlled Studies:

- The RGLs significantly improved the pilot's visual acquisition of the runway/taxiway holding position.
- Airport geometry and surface grading may impact the effectiveness of standard airport signage and markings. In such cases, RGLs can significantly improve the pilot's situational awareness.

Based on Pilot Surveys:

- RGLs were often cited as the single most effective component in accurately identifying the taxiway holding position. *(251 pilot surveys were collected as of December 2004)*
- Comments from pilot surveys:
 - *“Very Beneficial! All airports should have these.”*
 - *“Excellent for identifying hold line.”*

RGL Effectiveness Assessment Recommendations

- The FAA application of RGLs should be modified to include the use of RGLs specifically as a *runway incursion prevention tool* independent of weather conditions.
- Airports that currently have RGLs should operate them during *all operations*.
- During installations, RGLs should be powered such that they can be *operated independent of other lighting systems*.
- *The FAA should consider making RGLs available to airports specifically for runway incursion prevention when recommended by local RSAT.*

Runway Safety Projects

Runway Status Lights (RWSL)

➤ What?

- RWSL is a lighting system used to warn pilots and other operators that it is unsafe to enter a runway. Driven by surface surveillance systems:
 - Runway Entrance Lights (RELs): Red lights installed on the taxiway between the hold position marking and the runway to indicate the presence of high speed traffic on the runway
 - Take Off Hold Lights (THLs): Red lights in front of the takeoff-hold position that illuminate when the runway is unsafe for departure

Runway Safety Projects RWSL (Current Status)

- Accomplishments
 - Completed construction/installation of REL airfield lighting equipment
 - Completed REL shadow operations phase II
 - Completed REL pilot and controller training
 - Completed REL operational evaluation
 - Developed THL software

- What's next?
 - THL shadow operations testing
 - Construction/Installation of THL airfield lighting equipment

- Expected outcomes
 - THL Operational evaluation readiness decision

Runway Safety Projects RWSL (DFW Evaluation)





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